1990. Vertebrate Pest Management, a Training Manual, Joe E. Brooks Ejaz Ahmad, Iftikhar Hussain, Shahid Munir and A. Aziz Khan, editors, pgs. 43-48

METHODS OF RODENT POPULATION ESTIMATION

By Abdul Aziz Khan, Abdul Rauf Khokhar, Iftikhar Hussain and Joe E. Brooks

Rodent populations are studied and estimated with techniques which are biologically and statistically acceptable. Population estimates are helpful in calculating the extent of grain losses to rodents or in following the seasonal changes that occur in field crops during several growing cycles. Some methods give information on the distribution, size and species composition of the population while others give only indirect measures, such as activity measures. All have their uses, however, and several methods, both direct enumeration and indirect estimations, will be outlined.

A. Visual or Preliminary Survey Inside Structures

A preliminary survey of rodent populations inside structures (poultry houses, grain shops, godowns) will include:

1. Sounds: Gnawing, clawing, climbing, squeaks and noises etc.
2. Droppings: Found along runways, shelters and other places where rats frequent.
3. Urine: Wet or dry.
4. Smudge marks: May be found on pipes and roof beams in poultry farms particularly.
5. Runways: All walls, all fences, under bushes and buildings.
6. Tracks: Foot prints or tail marks on dusty surface or on spillage commodity, like flour. Use tracking patches (flour, chalk or talcum powder) to record tracks overnight.
7. Gnawing: Wood chips around baseboards, doors, basement, windows, frames, store materials provide evidence of rodent damage.
8. Nest and food caches.
9. Pet excitement: Cats and dogs show peculiar behaviour towards rats.
10. Rat odours: A peculiar smell indicates presence of rats or mice.
11. An experienced rat control worker can estimate low, medium and high population by seeing rat signs, burrows and food caches.
    a) Rat free or low infestation: No signs as mentioned above or few foot prints.
    b) Medium population: Old droppings, gnawing common,no rats seen in day time. There may be 10 or more rats in such situations.
    c) High population: Fresh droppings, tracks are common, gnawing present, one or more rats seen at day light or night. here may be 50 or more rats.
12. To record the above information you need the following equipment; a) Electric flashlight/ torch, (b) Tracking powder (c) Clipboard and record sheets

B. Trapping Methods

Both statistically and biologically reliable data can be obtained from trapping methods.

1. Trapping to Extinction

Complete trapping will give the actual population present in an area. This procedure is used in small godowns (500 tons capacity) or small poultry farms. The objective is to trap out all the rats possible and in a period not exceeding 21 days. This can be achieved both by live or kill trapping. Trapping is monitored by the foot prints on tracking patches. When the tracks are absent, all rodents have been trapped. It may sometimes happen that though the vast majority of rodents are trapped, a few reluctant individuals avoid the traps. The size and species composition of this residual population, provided it is very small, can often be estimated from the frequency of foot prints on the track patches.

2. Capture-Mark-Release (CMR) Method

A large number of studies has used a method based upon the recapture of marked individuals. Timewise this method is divided into two phases; first a sample of animals is caught alive, marked and released back into the original population. In the second phase, animals are again captured from the same population and the previously marked animals are recorded along with the new ones that are trapped. The method itself depends upon a very simple ratio. The population (P) is related to the number marked and released (M) in the same way as the total caught (n) at a subsequent time is related to the number of marked animals recaptured (m), or:

$$\frac{P}{M} = \frac{n}{m}, \text{ whence } P = \frac{Mn}{m}$$

As an example, assume we captured 100 rats in some grain shops in two days, marked them and released them back into the shops (M). One week later we again trap for two days and capture 90 rats (n) out of which 30 were marked (m). The population is estimated as:

$$P = \frac{100 \times 90}{30} = 300 \text{ rats}$$

There were an estimated 300 rats in the original population in the grain shops. The confidence limits at the 95% level may be calculated from the standard error:

$$S.E. = \sqrt{\frac{M^2 n(n-m)}{m^3}}$$

To determine the limits within which the population lies (95% confidence limits), add and subtract two standard errors from the estimate. Therefore, from our original estimate:

$$S.E. \doteq \sqrt{\frac{(100^2 \times 90)(90-30)}{100^3}} = 7.4 \times 2 = 14.8 \text{ (rounded to 15)}$$

Upper limits = 300 + 15 = 315
Lower limits = 300 - 15 = 285

Population estimates by this method will be based on two important assumptions:

a) No significant change in population takes place during the period of study.
b) The chance of capturing a rodent in the second phase is independent of whether or not it is marked.

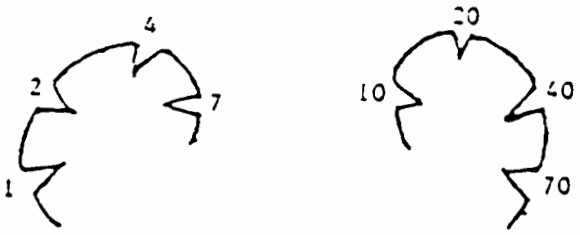
For trapping purposes the following equipment is needed:

a) 100 live traps (rat size)
b) 100 live traps (mouse size)
c) Cloth bag to hold live rodents for marking
d) 2 pairs of dissecting scissors
e) Spring balance (100 x 1 g)
f) Spring balance (500 x 5 g)
g) Marker
h) Trap baits

Animals can be marked by clipping one or more toes or by cutting notches in the ears. Toe clipping relies on using the forefoot digits for numbers 20, 30, etc. through 80 (each fore- foot has 4 toes) and using the hindfoot digits for numbers 1 through 10 (each foot has 5 digits). Thus 99 numbers are possible (Fig. 1). The ears can be clipped in a pattern representing the numbers 1,2,4 and 7, thus any number upto 9 can easily be clipped in one ear with only 2 notches. The other ear could be notched for numbers 10 through 90, thus giving 99 numbers.

Fore feet Hind feet
(With animal on its back)

CMR methods are laborious and time consuming. Moreover, shopkeepers or householders are not pleased to have the rats captured and then again released into their premises. For these reasons, these methods are rarely used in such premises. For outdoor field studies, however, these methods are quite suitable.



EARS

Fig. 1. Methods of marking animals.

3. Trapline Method

It is preferable to use a transect method in setting traps in the field. The traps are set in pairs. Such pairs are placed about 10 paces apart in a straight line and about 2-3 meters inside the crop from the edge. This allows two pairs of traps to fall within the home ranges covered by the line. If one rat is caught a second trap remains nearby to catch another animal. A buttered "chapatti" should be used which is attractive to a wide variety of rodents. Traps should be placed carefully upon flat and even ground. This is because even small animals do not like to step on something that tips or moves when touched. The relative abundance of animals is estimated through trapping success.

$$\% \text{ trap success} = \frac{\text{Number of animals caught}}{\text{Total trap nights}} \times 100$$

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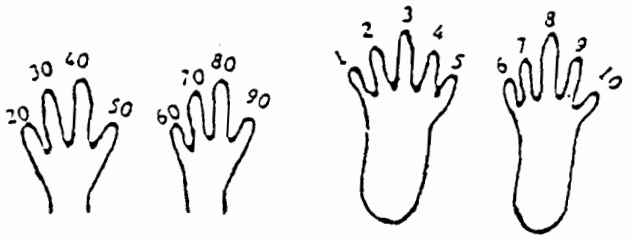

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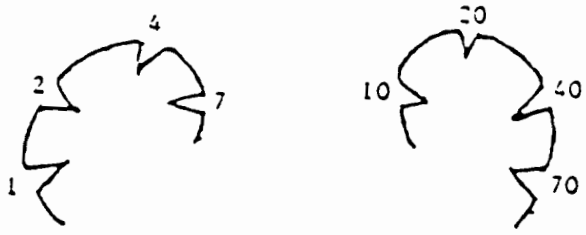

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$$\frac{T_1 - T_2}{n} = \frac{T_1}{P_1} = \frac{T_2}{P_2}$$

where T_1 is the proportion of tiles scored positive (with rat footprints) before removal trapping; T_2 is the proportion positive after removal trapping and n is the number of rats removed. The equation is solved for P_1, the original rat population. As an example, say the proportion of tiles positive before trapping was 0.80 (80 positive out of 100 set), and was 0.20 after removal trapping. We captured 120 rats, therefore:

$$P_1 = \frac{T_1 \times n}{T_1 - T_2} = \frac{0.8 \times 120}{0.8 - 0.2} = \frac{96}{0.6} = 160$$

The original rat population estimate was 160 animals. The method is simple, easy to run (takes only eight to 12 nights of tracking tiles and trapping) and pleases the shopkeeper or householder because most of the rats are removed from their premises. One disadvantage to this method is there is no way to calculate the confidence limits of the population estimate.

C. Indirect Methods

1. Food Consumption

One indirect method of population estimation is to use the amount of food baits consumed by a rat population over a period of up to 10 days. The method relies up the habit of rats to switch most of their nightly feeding over to a palatable, freely available food placed in abundance in their environment. This may be difficult in grain shops but has been done in some cases in godowns. In godowns where rice is stored, for example, bait containers with wheat mixed with 2% sugar and 2% oil will be utilized in preference to the rats normal diet of rice. The switch over takes up to 10 days, however, for all rats must find the new food baits and begin to do most of their feeding at the new bait sites. Generally, the consumption starts low but rises rapidly over the next three to four days (Fig. 3). However, baiting should be continued until consumption reaches a peak. The amounts consumed the last two to three days are averaged. This total is divided by the average daily consumption of wheat or other grain baits by the rodent species concerned. This gives a minimum estimate of the population since usually the animals continue to feed somewhat on their regular diet and some animals never do feed at the bait sites. A large number of bait sites must be used together with enough bait that the total amount at any one site is not entirely consumed overnight. The method is unreliable when more than one rodent species is present, since the proportion of consumption attributable to each is not known.

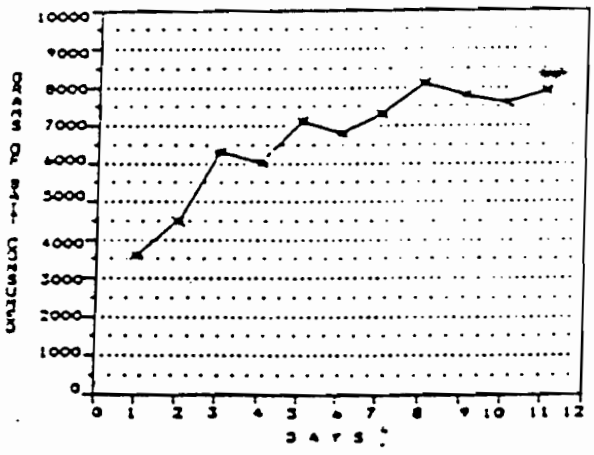

Fig. 3. Typical census bait consumption curve.

2. Tracking Patches and Tracking Tiles

Several indices of relative abundance can be used to estimate population changes from month to month or year to year. The activity index at tracking tiles can be used to measure relative population

activity (Table 1). Set approximately the same number of tiles for one or two nights each month. Score the number positive out of the total set.

Table 1: Index of Abundance: Activity at Tracking Tiles by Month and Catch/Unit Effort

Month	No. of Tiles Positive (%)	No. Trap-nights	No. Animals Captured	Captures Per Trapnight
Oct.	41.7	349	74	0.212
Nov.	50.0	468	74	0.158
Dec.	50.0	480	78	0.162
Jan.	33.3	576	80	0.139
Feb.	27.8	576	52	0.090
Mar.	27.8	576	24	0.042
Apr.	36.1	574	43	0.075
May	34.7	576	34	0.059
Jun.	25.0	576	46	0.080
Jul.	30.6	576	57	0.099
Aug.	32.3	576	61	0.106
Sep.	35.0	576	64	0.111

Similarly, setting an equal number of traps each month in a fixed number of grain shops or houses will give a catch/unit effort index or captures/trapnight (one trapnight means one trap set for one night; 100 traps set means 100 trapnights). Remember not to trap the same premises each month since the trapping will change the animal abundance.

Notice that the population abundance as measured by index of activity at tracking tiles was at a peak in November and December and then declined until reaching a low in June. Catch per unit effort, however, indicated a peak in abundance in October, declining slowly through January, and reaching lows in March and May. Overall there is reasonable agreement in the two indices in that population activity and numbers were high in October through January, lowest in February through June, and were increasing again in July through September.

3. Use of Tracking Patches and Food Intake at Bait Sites

Tracking patches are an indirect method of measuring rodent population using an activity index of prints on the track patches laid along the walls, beside the doors or across their runways. These patches of the size of 15 x 35 x 0.3 cm are laid using Fuller's earth, China clay, fertilizer dust, talc powder, gypsum etc. Patches with foot prints are recorded as positive.

There is another indirect method for estimating rodent numbers, i.e., food consumption data at least for 3 nights. Assuming that any rat or mouse species eats 10% of its body weight, the total rats/mice present in the area can be determined. Alternately, the eaten bait points are recorded and calculated and represented as follows:

$$\text{Percent rodent activity (track patches or food intake)} = \frac{\text{No. positive patches or food intake points}}{\text{Total No. of patches laid/food points}} \times 100$$

These two indirect methods are highly practical and useful in evaluating and control materials and methods and monitoring control programmes.